

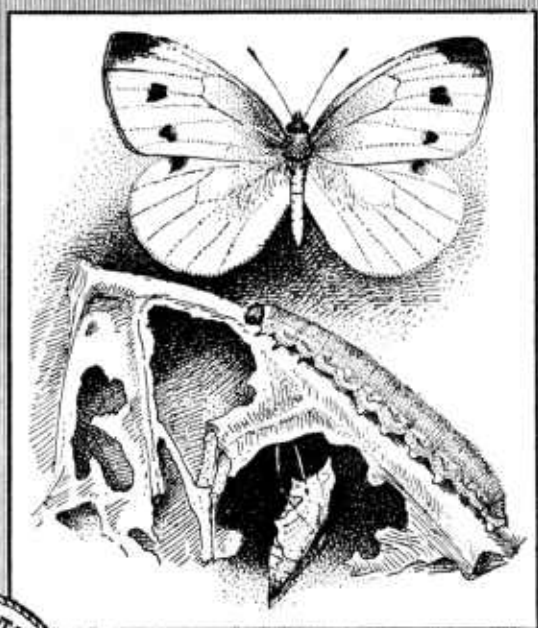
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# U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1461

## THE COMMON CABBAGE WORM AND ITS CONTROL



**T**HE COMMON CABBAGE WORM is the best known and most important of the many insect enemies of cabbage and related crops. It feeds upon the cabbage leaves and eats into the "buds" and heads. If not restrained by natural or artificial means it would frequently cause the total destruction of the crops which it attacks, since it multiplies rapidly and produces, even in the North, three broods or generations a year.

It is a velvety green worm, or caterpillar, measuring when full grown about  $1\frac{1}{4}$  inches in length, and is the larva, or young, of a white butterfly, well known to most farmers. It is found not only throughout the United States but almost all over the world. It begins work very early in the season and continues active until frost.

Natural enemies contribute very largely to the control of this pest, and in some seasons prevent its injuries from becoming serious. Wherever it occurs, however, it should be combated as soon as observed, and continuously as far as may be necessary. The best method of control lies in the use of common arsenic poisons—lead arsenate, calcium arsenate, or Paris green.

This bulletin is a revision of, and supersedes, Farmers' Bulletin 766, The Common Cabbage Worm.

# THE COMMON CABBAGE WORM<sup>1</sup> AND ITS CONTROL

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## INTRODUCTORY

THE MOST DESTRUCTIVE among the many insect and other enemies of cabbage and related crops is the larva, or caterpillar, of the common cabbage butterfly (figs. 1, 2). This caterpillar, the common cabbage worm, is well known to farmers throughout this country (and in the Old World as well), and the butterfly is generally recognized by the farmer as the parent of the "worms."

The common cabbage butterfly was introduced from Europe and was first recognized at Quebec, Canada, in 1860. In 1865 its first appearance in the United States was noted in Maine; in the following year in northern New Hampshire and Vermont. In 1868 it had reached New York and soon thereafter began to attract attention in other localities. In 1875 it appeared in Cleveland, Ohio, and two years later in Illinois. In 1880 it had penetrated southward to the Gulf States. The species has spread until now it is known in practically every State in the Union. It appears to favor no particular part of the country, being as destructive in the Gulf region as in Canada and New England.

## DESCRIPTION

This cabbage worm is velvety green, or of about the same color as the cabbage on which it feeds. There is a faint yellow stripe down the middle of the back and a row of yellow spots along each side in line with the breathing pores. The surface of the body, viewed through a hand lens, is seen to be somewhat rough and finely

<sup>1</sup> *Pieris rapae* L.; order Lepidoptera, family Pieridae.

dotted with small black spots. It measures, when full grown, about  $1\frac{1}{4}$  inches in length. (Fig. 1, *c*.) It differs mainly from the cabbage looper,<sup>2</sup> another caterpillar commonly found on such crops, in having five pairs of prolegs or prop legs (unjointed hind legs) instead of four. The cabbage looper, because of the limited number of its prop legs, "loops" in walking, like a measuring worm.

The butterfly has a wing expanse of nearly 2 inches. It is white, marked with black near the tops of the forewings. The female (fig. 1, *a*) has two conspicuous black spots on each forewing, whereas the male (fig. 2) has only one. The under side of the hind-wing is of a uniform straw-yellow color of satiny appearance, and in both sexes there is usually an indistinct black spot near its tip. The body of

the female is whitish; that of the male is usually darker on the back. The male is usually smaller than the female.

The eggs are spindle-shaped, of a pale yellowish color, strongly ribbed (fig. 1, *b*), and large enough to be seen readily with the unaided eye. They are laid by the butterfly singly, on end, and usually on the under side of the outer leaves of cabbage and other food plants.

When the caterpillar, or "worm," becomes full grown it attaches itself to a cabbage leaf or other near-by object by means of a threadlike girdle of silk, and is soon changed to a chrysalis, an inactive stage. (Fig. 1, *d*.) The chrysalis is a little less

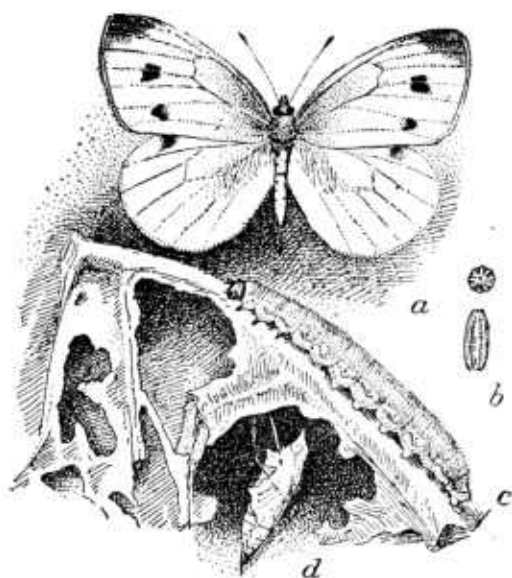


FIG. 1.—Common cabbage worm: *a*, Female butterfly; *b*, above, egg as seen from above; below, egg as seen from side; *c*, larva, or "worm," in natural position on cabbage leaf; *d*, suspended chrysalis; *a*, *c*, *d*, slightly enlarged; *b*, more enlarged

than three-fourths of an inch long, varying in color through dirty gray to yellow, green, and dark gray.

#### FOOD HABITS

The common cabbage worm feeds on all forms of cruciferous plants, being particularly fond of cabbage and cauliflower and less destructive to turnip, kale, collards, radish, mustard, and horse-radish.

The butterflies sip the nectar of flowers of various kinds and are commonly seen hovering over them. They are especially fond of the white blossoms of crucifers, and of white aster, lavender, heliotrope, and thistle. Like other butterflies, this species is active by day, being on the wing from early morning until near dusk. It is

<sup>2</sup> *Autographa brassicae* Riley.

a comparatively slow but tireless flyer, capable of journeying long distances.

#### LIFE HISTORY

The butterflies appear on warm, sunny days as early as March, even in the Northern States, and thereafter may be seen flying until after several severe frosts in October. In the Gulf region they occur throughout the season. Pairing and egg laying begin within a day or two after the adult comes out of the chrysalis.

The different stages naturally vary in duration, depending on temperature conditions, the egg stage lasting from four to eight days.

The caterpillar, which hatches from the egg, eats greedily and grows rapidly, reaching maturity in from 10 to 14 days after hatching. It molts four times; there are therefore five distinct stages of growth, the first molt taking place, in the warmest weather, in about 2 days from the time of hatching, the second stage lasting from 2 to 3 days, the third and fourth from 1 to 2 days each, and the fifth from 4 to 5 days. In the summer time the chrysalis period lasts

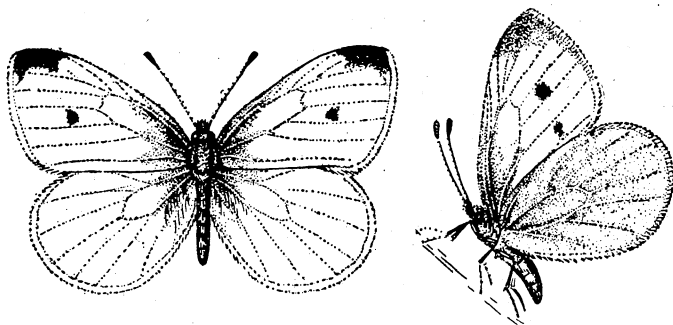


FIG. 2.—Common cabbage butterfly: Male, wings spread at left, wings folded at right. Somewhat enlarged

from 7 to 12 days. In the more northerly States the insect passes the winter as a chrysalis, and the butterflies appear the following spring.

The period of development (egg to butterfly) covers between 22 and 42 days. In New England and Wisconsin this species is credited with producing three generations in a season, and five or six are reported for North Carolina.

#### NATURE OF INJURY

This cabbage worm has been rightly termed the bane of the cabbage grower and the dread of the housewife. It begins work early in the season, damaging young plants. After riddling the outer leaves it attacks the tender inner leaves as they form, frequently feeding within the immature heads and rendering the cabbage unfit for food because of the abundant dark-green excrement which it deposits. Before cooking it is frequently necessary to tear the head apart to insure that no disgusting worms are concealed within. In cool weather the caterpillar often feeds freely exposed on the surface of the leaves in the sunshine.

Frequently the worm works into the center of the cabbage, attacking the undeveloped "heart" and rendering the head worthless for market. (See fig. 3.) Seedling cabbage grown in cold frames is often damaged shortly after it is set in the field, the worm cutting

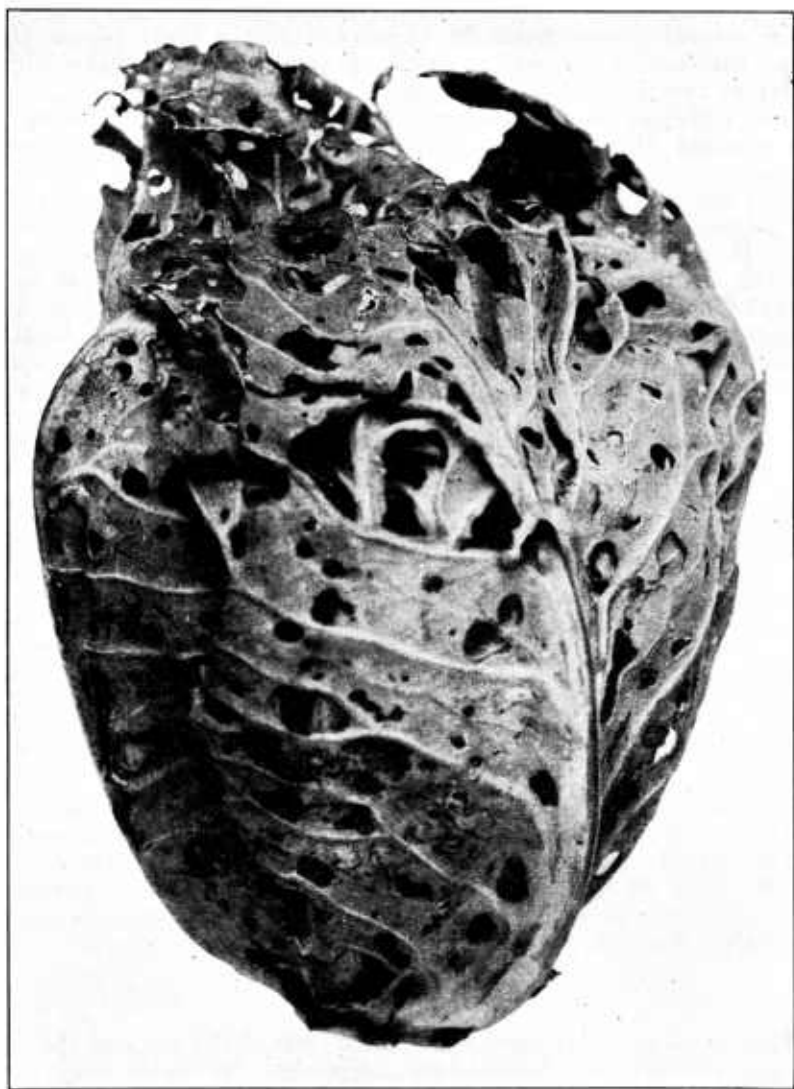


FIG. 3.—Immature cabbage head, showing injury by worms feeding within. Reduced one-half

out the "bud," and thus destroying the future head. Injury of this nature may be very serious, many plants being a complete loss. Somewhat unusually the worms occur in such numbers as to congregate on a single leaf and devour it in a very short time. (See fig. 4.)

## NATURAL ENEMIES

Were it not for certain natural checks this insect would be a still greater pest. The most important of its insect enemies are small wasplike parasites, or four-winged flies, the immature forms of which feed within the body of the cabbage worm. All are introductions from Europe. One of the most efficient of these, the cabbage-worm ichneumon fly<sup>3</sup> (figs. 5, 6), was purposely imported in 1883 from England as a means of controlling this cabbage worm, and has more than justified its introduction. During the fall of 1904 this parasite held its host under complete control at Washington, D. C., killing every worm which came under the writer's observation. The cabbage-worm chalcid fly<sup>4</sup> (fig. 7) bears the same relation to the cabbage worm as does the ichneumon fly, and is therefore beneficial, especially in the Northern States. As it was first noted in this country in 1869, it was evidently imported with its host. The eggs of this chalcid fly are deposited in the cabbage worm, hatch into larvæ, and live within it, and the adult parasites which develop from them come out from the chrysalis stage of the worm.

Large wasps, particularly certain paper wasps<sup>5</sup> and related forms, are also of great service in reducing the numbers of this and other cabbage worms, appearing to prefer them to other prey.

The small, evil-smelling ambush bug<sup>6</sup> hides in flowers, such as the thistle and golden-rod, and destroys numbers of butterflies, capturing them and sucking out their body fluids.



FIG. 4.—Remains of cabbage leaf eaten by seven common cabbage worms. Slightly enlarged

<sup>3</sup> *Apanteles glomeratus* L.

<sup>4</sup> *Pteromalus puparum* L.

<sup>5</sup> *Polistes metricus* Say, *P. pallipes* Lepel., and others.

<sup>6</sup> *Phymata wolfi* Stål.



Numerous other insect enemies<sup>7</sup> attack this cabbage worm, and it is sometimes subject to a contagious bacterial disease<sup>8</sup> similar to that of the cabbage looper. It is not especially susceptible to this malady, although in some seasons great numbers are destroyed by it.

Birds which are known to feed upon cabbage worms are the chipping sparrow, English sparrow, and house wren. It is certain, however, that other birds eat them, and in one case it was reported that during the winter the number of chrysalids (resting stage) of the cabbage butterfly were reduced more than 90 per cent by birds.

### CONTROL ON CABBAGE

The common cabbage worm is not difficult to control if proper remedies are used as soon as damage is detected and before the worms become too abundant.

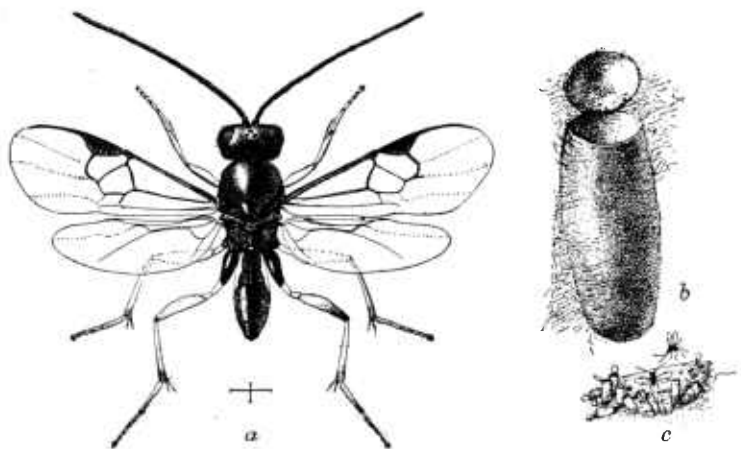


FIG. 5.—Cabbage-worm ichneumon fly, a valuable parasite of the common cabbage worm: a, Adult fly; b, cocoon; c, flies escaping from cocoons. a, b, highly magnified; c, natural size

### ARSENICALS OR ARSENIC POISONS

The best remedy is poisoning with some form of arsenical; of these lead arsenate, calcium arsenate, and Paris green are about equally effective. The poison may be applied to the plants either as a spray or as a dust.

### SPRAYS

Lead arsenate has largely taken the place of Paris green as an insecticide. It is less harmful to growing plants, sticks better to the leaves, and in water does not settle as quickly as does Paris green. Lead arsenate as a spray is also valuable in that it leaves, on drying, a white coating on the plants, so that after spraying it is easy to

<sup>7</sup> Among other predacious enemies observed in this country are the wheel bug (*Arilus cristatus* L.), the armed soldier-bug (*Podisus maculiventris* Say), the parasitic tachina flies *Exorista vulgaris* Fall. and *Frontina archippivora* Will., and a flesh fly, *Sarcophaga* (*Boettcheria*) *latisterna* Parker. About 10 additional parasites are listed in Europe.

<sup>8</sup> *Micrococcus pieridis* Burrill.

see which plants have been treated and how thorough the treatment has been. The spray should be mixed as follows:

Lead arsenate (powder)-----	2 pounds	} or {	½ pound.
Soap-----	2 pounds		½ pound.
Water or Bordeaux mixture-----	50 gallons		12½ gallons.

Calcium arsenate has a higher arsenic content than lead arsenate and therefore possesses greater killing power. Its adhesiveness is about the same as that of lead arsenate. The spray should be mixed as follows:

Calcium arsenate (powder)-----	1½ pounds	} or {	6 ounces.
Soap-----	2 pounds		8 ounces.
Water or Bordeaux mixture-----	50 gallons		12½ gallons.

For small amounts of sprays use 10 level teaspoonfuls of the arsenical to 1 gallon of water and about 1¼ ounces of soap.

Paris green was one of the first poisons used for the control of leaf-feeding insects. The objections to its use are that it is likely to injure foliage, it does not remain mixed with water for any length of time, and does not

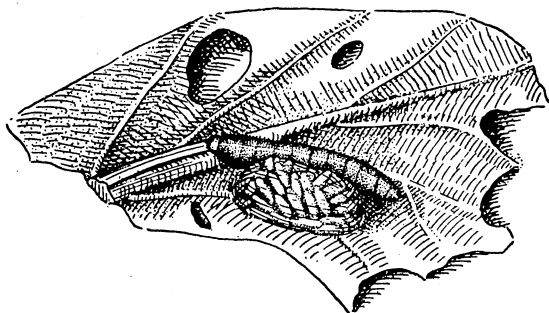


FIG. 6.—Parasitized cabbage worm, showing cocoon mass of cabbage-worm ichneumon fly below

stick well to leaves such as those of cabbage and cauliflower. The spray should be mixed in the following proportions:

Paris green-----	1 pound	} or {	4 ounces.
Soap-----	2 pounds		8 ounces.
Water or Bordeaux mixture-----	50 gallons		12½ gallons.

The sticking and spreading qualities of these spray materials are improved by the addition of soap, which is particularly valuable in sprays to be used on such types of leaves as those of cabbage. Effective treatment requires about 150 gallons of spray to the acre for one application. When applied with a hand sprayer about 1 gallon of the spray to 50 feet of row will be required.

#### DUSTS

Arsenic poisons may be applied in dust form by mixing the poison with a cheap carrier, such as hydrated or air-slaked lime, land plaster, dusting sulphur, or other cheap, light, finely pulverized material, which will adhere to the cabbage leaves.

Dusts are more easily and quickly applied than sprays, but do not always distribute the poison so evenly. Unless applied when the foliage is wet, the dust does not stick so well as does a spray mixture.

The following mixtures are recommended :

Lead arsenate -----	1 pound.
Hydrated lime -----	5 pounds.
Or	
Calcium arsenate -----	1 pound.
Hydrated lime -----	5 pounds.
Or	
Paris green -----	1 pound.
Hydrated lime -----	15 pounds.

The dusts should be applied at the rate of about 30 to 40 pounds to the acre.

#### PREPARATION OF SPRAY MIXTURES

When preparing the spray mixtures in quantities, such as from 25 to 100 gallons, proceed as follows: Fill the spray tank about half full of water, running it through a fine strainer. The proper amount of poison, depending upon the capacity of the sprayer, should then be mixed with a small amount of water in a 3-gallon pail or other small container by thoroughly stirring the mixture so as to wet and separate the particles of poison. Then pour this concentrated mixture through a

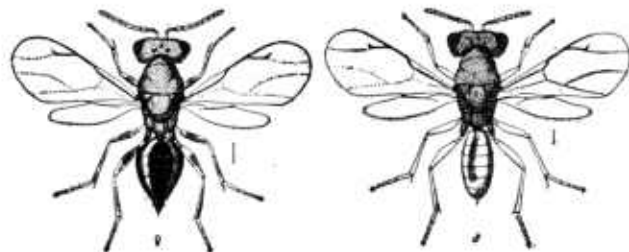


FIG. 7.—Cabbage-worm chalcid fly, a useful parasite of the common cabbage worm. Female at left, male at right. Size shown by hair line at right

concentrated mixture through a strainer into the spray tank and add the full amount of water to the sprayer. The soap should be dissolved in small quantities of hot water before it is added to the spray.

It is good practice to prepare the soap solution some time before spraying is to begin, so that the time consumed in dissolving the soap will not cause any unnecessary delay in the spray work.

In preparing small quantities of spray mixtures the poison should be first mixed with a little water and thoroughly stirred before the full amount of water is added. Unless the spray is kept fairly well agitated or stirred, the poison will separate from the water and settle to the bottom of the tank. It is therefore necessary, in order to keep the spray mixture uniform, that the sprayer be equipped with a good agitator or some means be taken to stir the spray mixture from time to time. In the case of hand compressed-air sprayers, these can be shaken vigorously at intervals and a wooden paddle can be used to keep the spray mixture stirred in bucket pumps not equipped with agitators.

#### PREPARATION OF DUSTS

In the preparation of poisoned dust mixtures the principal object is to mix the poison thoroughly with the material which is used to dilute the poison, such as hydrated lime, land plaster, etc. A satis-

factory mixture can be prepared in 50 to 100 pound lots by placing the materials in a steel drum or barrel which can be tightly closed and then rolling the drum for a distance of 400 to 500 feet. At intervals of about 50 feet the drum should be turned end over end a few times. Another method, which can be employed when a steel drum is not available, is to mix the dust in a flat box with a garden hoe. The lime or other substance which is to be used to dilute the poison should be spread out in a thin layer over the bottom of the box and about one-fourth of the poison should be evenly distributed over this layer and the two materials mixed thoroughly with the hoe. The dust should then be drawn up in a pile to the center of the box, care being exercised to remove it from the corners. This mixture should then be spread out in a thin layer, another fourth of the poison added, and the mixing process repeated. This procedure should be continued until all the poison is mixed with the material which is used to dilute it. Any poison mixtures which remain

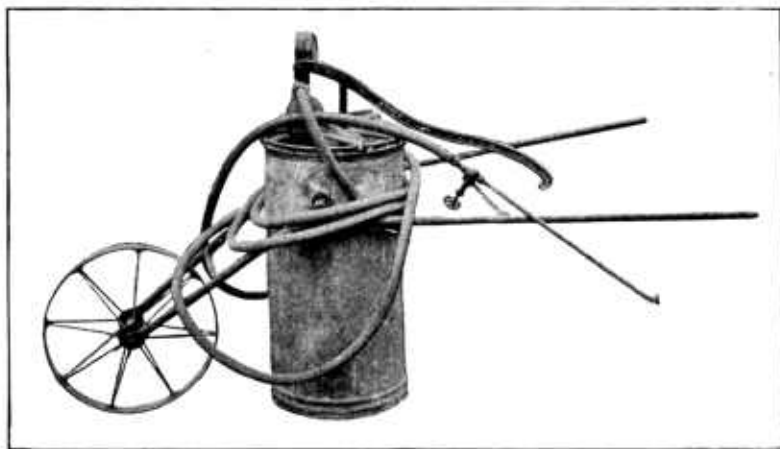


FIG. 8.—Wheelbarrow type of sprayer; effective for moderate-sized areas

unused after dusting operations should be plainly marked "Poison" and stored until needed.

#### SPRAY EQUIPMENT

For the application of sprays, machines that will develop a high pressure are the most satisfactory. Where large acreages are to be treated, the arsenicals may be applied by power or traction sprayers. In power sprayers the pump is usually operated by a gas engine, and in traction sprayers the pump is operated from a wheel of the spray cart. The spray should be applied to each row of plants by three nozzles, one directed downward and one to each side of the row.

For smaller plantings a barrel or wheelbarrow type of sprayer will be found satisfactory. (See fig. 8.) In small garden patches a hand sprayer of the compressed-air type (fig. 9) does effective work.

The nozzles used should be of the type which delivers a cone-shaped spray. Under pressure this type of nozzle gives a fine, mist-like spray, very desirable for effective results.

#### DUSTERS

Power or traction dusters (fig. 10) are most useful for large plantings. Hand dusters (fig. 11) may be used with success on one or two acres.



FIG. 9.—Compressed-air sprayer in operation. Note method of carrying. Right hand controls outlet valve

Dust may be applied to garden plantings by means of a cheese-cloth sack (fig. 12) shaken over the plant, or by means of a tin can with holes punched in the bottom of it the size of a 10-penny nail, and a stick for a handle attached to its side. The dust is applied by shaking the can over the plant. Treatment by these methods is



FIG. 10.—Traction type of duster in operation in cabbage field



FIG. 11.—Dusting cabbage field. Note cloud of dust completely covering all parts of plants

not so effective as that obtained by the use of machinery made for dusting purposes.

#### ARSENICALS SAFE TO USE ON CABBAGE IF PROPERLY APPLIED

Arsenicals can be applied with safety until the heads of the cabbages are nearly formed, as the poison disappears almost completely within two or three weeks after application, and even earlier if there are frequent rains. Arsenic should not be applied just before the cabbage is cut or if the worms have tunnelled into the mature head. After the removal of the outer leaves, in preparing cabbage for market, and after other useless leaves have been picked off, as is done before the cabbage is cooked or prepared for salad, usually very little, if any, arsenic is left.

Chemical analysis has shown that a week after cabbage had been sprayed with an arsenic poison as prescribed in this bulletin, and prepared for cooking in the usual manner—that is, by removing all loose outer leaves—not a trace of arsenic remained. The writer knows of no authentic recorded instances of poisoning from the consumption of cabbage treated with an arsenical poison. It is not recommended that arsenical poisons be used on cabbage in cases where the outer leaves are to be used for human food as “greens,” or are to be fed to livestock.



FIG. 12.—Dusting cabbage with cheese-cloth bag

#### CONTROL ON OTHER CROPS

Arsenical treatment, as recommended for the control of the worm on cabbage, can be employed to protect seedling crops of cauliflower, Brussels sprouts, collards, turnips, kale, and mustard. In the treatment of cauliflower and Brussels sprouts arsenicals can be applied with safety until the edible heads of the cauliflower or the “sprouts” of the Brussels sprouts appear, but after this period in the development of the plant the use of arsenical poisons *should be avoided*, as the edible portions of the plant are likely to retain some of the poison at harvest. Turnips, kale, and similar plants which bear edible foliage should receive applications of the poison only in the seedling stage of the crop.

#### CLEAN FARMING

If by any possibility cooperation in clean methods of farming and in the use of arsenicals could be obtained, much of the loss due to the cabbage worms might be averted. The practice of leaving cabbage

stalks and heads and remnants unfit for market in the field after the main crop has been harvested should be avoided. All remnants should be disked or plowed under.

#### **SUMMARY**

The common cabbage worm is a velvety green caterpillar, about  $1\frac{1}{4}$  inches long when full grown. It is the larva or young of a white butterfly. It begins work on young plants soon after they are set out, and will, if unmolested, riddle the outer leaves and eat into the "buds" and heads. As a result of its activities entire crops are sometimes seriously damaged.

It is a serious menace to the cultivation of cabbage, cauliflower, turnip, and related crops, and the farmer must be prepared to combat it during their growth. In the warmest weather it can develop from egg to adult, or butterfly, in a minimum of 22 days. Even in its northernmost range it develops three generations, or broods, annually, and southward there may be as many as six distinct generations.

Natural enemies contribute largely to the control of this insect. Without them it would be still more destructive. It is necessary, however, to resort to insecticides for satisfactory control, the most useful being lead arsenate, calcium arsenate, and Paris green, applied either as sprays or dusts. The method of application can be varied according to the area to be treated. If properly applied arsenical poisons can be safely used for this purpose.

Cooperation in clean methods of farming, if it could be brought about, would do much to avert the ravages of the cabbage worm.



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